

**PrePARED Report No. 9**  
**Offshore Wind Farm Cumulative Effects Assessments – Case Study 1: Including projects without an EIA**



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## PrePARED Report

# Offshore Wind Farm Cumulative Effects Assessments – Case Study 1: Including projects without an EIA

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### Summary

Some Cumulative Effects Assessments (CEAs) screen out projects where a quantitative assessment of the number of animals impacted is not available (i.e. no EIA is available). Other CEAs acknowledge that offshore wind farm (OWF) projects should be considered and use a set of assumptions to estimate the number of animals disturbed. The purpose of this case study was to demonstrate (using iPCoD population modelling) the difference in a quantitative CEA depending on whether projects without an EIA are included in the assessment or not. Two scenarios were run in iPCoD to model the population level effects of disturbance:

- **Scenario 1: EIA Projects Only** - all planned OWF located in the North Sea MU that have an EIA, and
- **Scenario 2: All Projects** -all planned OWF located in the North Sea MU both with and without an EIA, using an effective deterrence range (EDR) and the SCANS IV density to estimate the number of impacted animals for projects without an EIA.

Despite substantially different inputs in terms of the number of projects and the number of piling days between the two scenarios, the population level results were almost identical. The reason for this is apparent when comparing the number of animals potentially disturbed by each project in the two scenarios. The number of animals predicted to be impacted for projects without an EIA are vastly smaller than those predicted in EIAs. Therefore, the results from the two different methods are markedly different and incompatible, and caution used when comparing. This needs to be taken into consideration when reviewing CEAs, and Regulators and Statutory Advisors need to provide clear guidance as to what methods should be used and how to best account for projects without an EIA.

## **Recommended Citation**

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## 1. Introduction

Environmental Impact Assessments (EIAs) in the UK must include a Cumulative Effects Assessment (CEA). Typically, offshore wind farm (OWF) CEAs quantitatively assess the potential for population level effects resulting from disturbance from pile driving across multiple OWF developments. However, due to a lack of standardisation or guidance this process varies considerably between assessments (especially by country and by project) (Sinclair 2025). This raises the question of the utility and efficiency of the current CEA process.

Where no prediction of the number of animals impacted is available (i.e. no EIA is available) some CEAs will simply screen out those projects. Other CEAs acknowledge that these projects should be considered quantitatively in some way and use a set of assumptions to provide an illustrative number of animals disturbed, typically by using an effective deterrence range (EDR) to estimate the disturbance area.

The purpose of this case study was to demonstrate the difference in a CEA depending on whether projects without an EIA are included in a quantitative assessment or not.

## 2. Method

### 2.1 Scenarios considered

This case study assessed the potential for population level impacts to the North Sea harbour porpoise Management Unit (MU) population from the cumulative impact of disturbance from pile driving of OWFs in the MU. Two scenarios were considered:

1. **Scenario 1: EIA Projects Only** – this quantitatively assessed the cumulative effect of all OWFs located in the North Sea MU that have an EIA available in the public domain (see section 6: EIAs reviewed).
2. **Scenario 2: All Projects** - this quantitatively assessed the cumulative effect of all OWF located in the North Sea MU (both with and without an EIA available in the public domain).

For **Scenario 1: EIA Projects Only**, the following information was obtained from OWF specific EIAs: number of animals disturbed per piling day, the expected piling years and the number of piling days (where available) (see Table 1).

**Table 1 Scenario 1: OWF projects with an EIA available**

| OWF                                   | Pile type           | Piling days | Start      | End        | # Disturbed per piling day (from EIAs) |
|---------------------------------------|---------------------|-------------|------------|------------|----------------------------------------|
| Berwick Bank                          | Pin Piles           | 372         | Jan-26     | Dec-31     | 2,822                                  |
| Caledonia                             | Pin Piles & Anchors | 515         | 2028       | 2030       | 8,201                                  |
| Dogger Bank A (Creyke Beck A)         | Monopiles           | 95          | 2023       | Dec-25     | 1,470                                  |
| Dogger Bank B (Creyke Beck B)         | Monopiles           | 95          | May-24     | 2025       | 2,599                                  |
| Dogger Bank C (Dogger Bank Teeside A) | Monopiles           | 87          | 2025       | 2026       | 1,920                                  |
| Doggerbank Southeast                  | Monopiles           | 100         | 2028       | 2030       | 4,296                                  |
| Doggerbank Southwest                  | Monopiles           | 100         | 2028       | 2030       | 5,098                                  |
| Dudgeon Extension                     | Pin Piles           | 60          | 2028       | 2028       | 5,161                                  |
| East Anglia 1 North                   | Pin Piles           | 134         | 2026       | 2028       | 2,914                                  |
| East Anglia 2                         | Pin Piles           | 150         | 2025       | 2027       | 3,285                                  |
| East Anglia 3                         | Pin Piles           | 344         | 2025       | 2027       | 2,211                                  |
| Five Estuaries                        | Pin Piles           | 85          | 2029       | 2030       | 5,677                                  |
| Green Volt                            | Pin Piles           | 4           | Q1 2027    | Q1 2027    | 5,208                                  |
| Hornsea 3                             | Pin Piles           | 554         | 2027       | 2028       | 4,046                                  |
| Hornsea 4                             | Pin Piles           | 270         | Q4 2026    | Q3 2027    | 6,417                                  |
| Inch Cape                             | Pin Piles           | 76          | Dec-25     | May-26     | 175                                    |
| Muir Mhòr (WTG)                       | Anchors             | 175         | Jun-29     | Jun-31     | 14,630                                 |
| Muir Mhòr (OSP)                       | Pin Piles           | 24          | Jun-29     | Jun-31     | 15,245                                 |
| Norfolk Boreas                        | Pin Piles           | 386         | 01/04/2026 | 30/09/2027 | 1,016                                  |
| Norfolk Vanguard                      | Pin Piles           | 417         | 2027       | 2028       | 15,959                                 |
| North Falls                           | Pin Piles           | 103         | 2030       | 2030       | 2,274                                  |
| Ossian (WTG)                          | Anchors             | 530         | 2031       | 2038       | 3,857                                  |

|                                      |           |     |         |         |        |
|--------------------------------------|-----------|-----|---------|---------|--------|
| <b>Ossian (OSP)</b>                  | Pin Piles | 72  | 2031    | 2038    | 7,309  |
| <b>Outer Dowsing</b>                 | Pin Piles | 130 | Q3 2027 | Q2 2029 | 1,799  |
| <b>Pentland</b>                      | Anchors   | 63  | 2025    | 2026    | 641    |
| <b>Rampion 2</b>                     | Pin Piles | 95  | Jul-29  | Feb-30  | 652    |
| <b>Salamander</b>                    | Anchors   | 80  | Apr-28  | Oct-28  | 12,366 |
| <b>Sheringham Shoal Extension</b>    | Pin Piles | 50  | 2028    | 2028    | 445    |
| <b>Sofia (Dogger Bank Teeside B)</b> | Monopiles | 100 | 2025    | 2026    | 2,035  |
| <b>West of Orkney</b>                | Pin Piles | 290 | 2028    | 2030    | 1,149  |

For **Scenario 2: All Projects**, for projects in the North Sea MU with no EIA available, a search was conducted into planned OWF in the UK, Germany, Sweden, Denmark, the Netherlands and France. Data were sourced on the expected foundation type (fixed or floating), the maximum number of wind turbine generators (WTGs) (or maximum GW capacity) and the potential construction timelines (see Table 2). The following sources were used in this search:

- OWF specific scoping report (where available)
- OWF specific websites (where available)
- Developer websites (e.g. Orsted, Vattenfall, SSE, RWE, EnBW)
- Noordzeeloket.nl (offshore wind energy database for the Netherlands)
- Bsh.de (The Federal Maritime and Hydrographic Agency in Germany)
- 4coffshore.com (Global offshore wind farm database)
- thewindpower.net (Wind Energy Database)
- power-technology.com (offshore wind news and information platform)
- OffshoreWIND.biz (offshore wind news and information platform)

Projects were screened out of the assessment if there was no information available on the potential construction timelines. For all projects, where information was not available to inform the assessment, the following assumptions were made with respect to the spatial extent of behavioural disturbance, density and piling duration (in order to estimate the number of animals disturbed per day, expected piling years and number of piling days):

- Monopile = 26 km EDR (JNCC 2020)
- Jacket = 15 km EDR (JNCC 2020)
- Floating anchor = 15 km EDR (assumed similar to jacket pin piles)
- Mitigated piling = 15 km EDR (JNCC 2020)
- Density = SCANS IV block (Gilles et al. 2023)
- Monopile = 1 piling day
- Jacket = 2 piling days
- Anchors = 4 piling days

**Table 2 OWF projects without an EIA available (included in Scenario 2 in addition to all those listed in Table 1)**

| OWF                                                    | Country        | Pile type | # WTGs | Piling days | Start | End  | # Disturbed per piling day<br>(estimated using EDR &<br>SCANS IV block density) |
|--------------------------------------------------------|----------------|-----------|--------|-------------|-------|------|---------------------------------------------------------------------------------|
| <b>Arven</b>                                           | United Kingdom | Floating  | 161    | 725         | 2026  | 2030 | 364                                                                             |
| <b>Ayre</b>                                            | United Kingdom | Floating  | 67     | 302         | 2029  | 2032 | 199                                                                             |
| <b>Bowdun</b>                                          | United Kingdom | Floating  | 67     | 302         | 2029  | 2031 | 423                                                                             |
| <b>Buchan</b>                                          | United Kingdom | Floating  | 70     | 315         | 2028  | 2030 | 364                                                                             |
| <b>Morven</b>                                          | United Kingdom | Floating  | 191    | 573         | 2027  | 2030 | 423                                                                             |
| <b>Atlantis I</b>                                      | Germany        | Fixed     | 73     | 146         | 2024  | 2029 | 435                                                                             |
| <b>Bluewater - Metcentre</b>                           | Norway         | Floating  | 1      | 4           | 2026  | 2026 | 87                                                                              |
| <b>Borkum Riffgrund 3</b>                              | Germany        | Monopile  | 83     | 83          | 2024  | 2025 | 435                                                                             |
| <b>Centre-Manche 1</b>                                 | France         | Monopile  | 67     | 67          | 2025  | 2031 | 74                                                                              |
| <b>Centre-Manche 2</b>                                 | France         | Monopile  | 100    | 100         | 2026  | 2032 | 74                                                                              |
| <b>Dieppe Le Treport</b>                               | France         | Jacket    | 33     | 66          | 2024  | 2026 | 74                                                                              |
| <b>Dunkerque</b>                                       | France         | Monopile  | 46     | 46          | 2024  | 2028 | 74                                                                              |
| <b>Freya</b>                                           | Denmark        | Floating  | 50     | 200         | 2025  | 2029 | 334                                                                             |
| <b>Hanstholm Syd</b>                                   | Denmark        | Fixed     | 11     | 21          | 2024  | 2028 | 334                                                                             |
| <b>Hirtshals Havn Offshore</b>                         | Denmark        | Fixed     | 9      | 17          | 2024  | 2028 | 367                                                                             |
| <b>HKW Kavel VII</b>                                   | Netherlands    | Fixed     | 47     | 93          | 2023  | 2025 | 568                                                                             |
| <b>Hollandse Kust west zuidelijk deel<br/>(HK-w-z)</b> | Netherlands    | Monopile  | 108    | 108         | 2024  | 2026 | 568                                                                             |
| <b>IJmuiden Ver (Alpha)</b>                            | Netherlands    | Fixed     | 133    | 267         | 2028  | 2030 | 568                                                                             |
| <b>IJmuiden Ver (Beta)</b>                             | Netherlands    | Fixed     | 133    | 267         | 2028  | 2029 | 219                                                                             |
| <b>IJmuiden Ver (Gamma A)</b>                          | Netherlands    | Fixed     | 67     | 133         | 2028  | 2030 | 568                                                                             |

|                                                        |             |          |     |     |      |      |     |
|--------------------------------------------------------|-------------|----------|-----|-----|------|------|-----|
| <b>IJmuiden Ver (Gamma B)</b>                          | Netherlands | Fixed    | 67  | 133 | 2028 | 2030 | 219 |
| <b>Jyske Banke Nord</b>                                | Denmark     | Fixed    | 73  | 147 | 2027 | 2031 | 334 |
| <b>Mareld</b>                                          | Sweden      | Fixed    | 167 | 333 | 2030 | 2032 | 367 |
| <b>N-10.1</b>                                          | Germany     | Fixed    | 10  | 20  | 2026 | 2030 | 435 |
| <b>N-10.2</b>                                          | Germany     | Fixed    | 10  | 20  | 2026 | 2030 | 435 |
| <b>N-11.1</b>                                          | Germany     | Fixed    | 133 | 267 | 2026 | 2030 | 435 |
| <b>N-12.1</b>                                          | Germany     | Fixed    | 133 | 267 | 2026 | 2030 | 435 |
| <b>N-12.2</b>                                          | Germany     | Fixed    | 133 | 267 | 2026 | 2030 | 435 |
| <b>N-6.6</b>                                           | Germany     | Fixed    | 42  | 84  | 2026 | 2028 | 435 |
| <b>N-6.7</b>                                           | Germany     | Fixed    | 9   | 18  | 2025 | 2029 | 568 |
| <b>N-9.1</b>                                           | Germany     | Fixed    | 10  | 20  | 2029 | 2031 | 568 |
| <b>N-9.2</b>                                           | Germany     | Fixed    | 10  | 20  | 2030 | 2032 | 435 |
| <b>N-9.4</b>                                           | Germany     | Fixed    | 10  | 20  | 2026 | 2030 | 568 |
| <b>Nordlicht I</b>                                     | Germany     | Fixed    | 65  | 131 | 2026 | 2027 | 435 |
| <b>Nordseecluster A</b>                                | Germany     | Fixed    | 44  | 88  | 2026 | 2027 | 435 |
| <b>Nordseecluster B</b>                                | Germany     | Fixed    | 60  | 120 | 2028 | 2029 | 435 |
| <b>Parc eolien pose au large de la Normandie (AO4)</b> | France      | Fixed    | 44  | 88  | 2030 | 2031 | 74  |
| <b>Poseidon Nord</b>                                   | Sweden      | Floating | 93  | 373 | 2027 | 2031 | 367 |
| <b>Poseidon Syd</b>                                    | Sweden      | Floating | 93  | 373 | 2027 | 2031 | 653 |
| <b>Romo</b>                                            | Denmark     | Fixed    | 15  | 30  | 2025 | 2029 | 435 |
| <b>Ten Noorden van de Waddeneilanden Zone</b>          | Netherlands | Fixed    | 47  | 93  | 2027 | 2031 | 568 |
| <b>Thor - 2020 Tender</b>                              | Denmark     | Fixed    | 72  | 144 | 2024 | 2026 | 435 |
| <b>Thybo I</b>                                         | Denmark     | Fixed    | 200 | 400 | 2025 | 2029 | 334 |

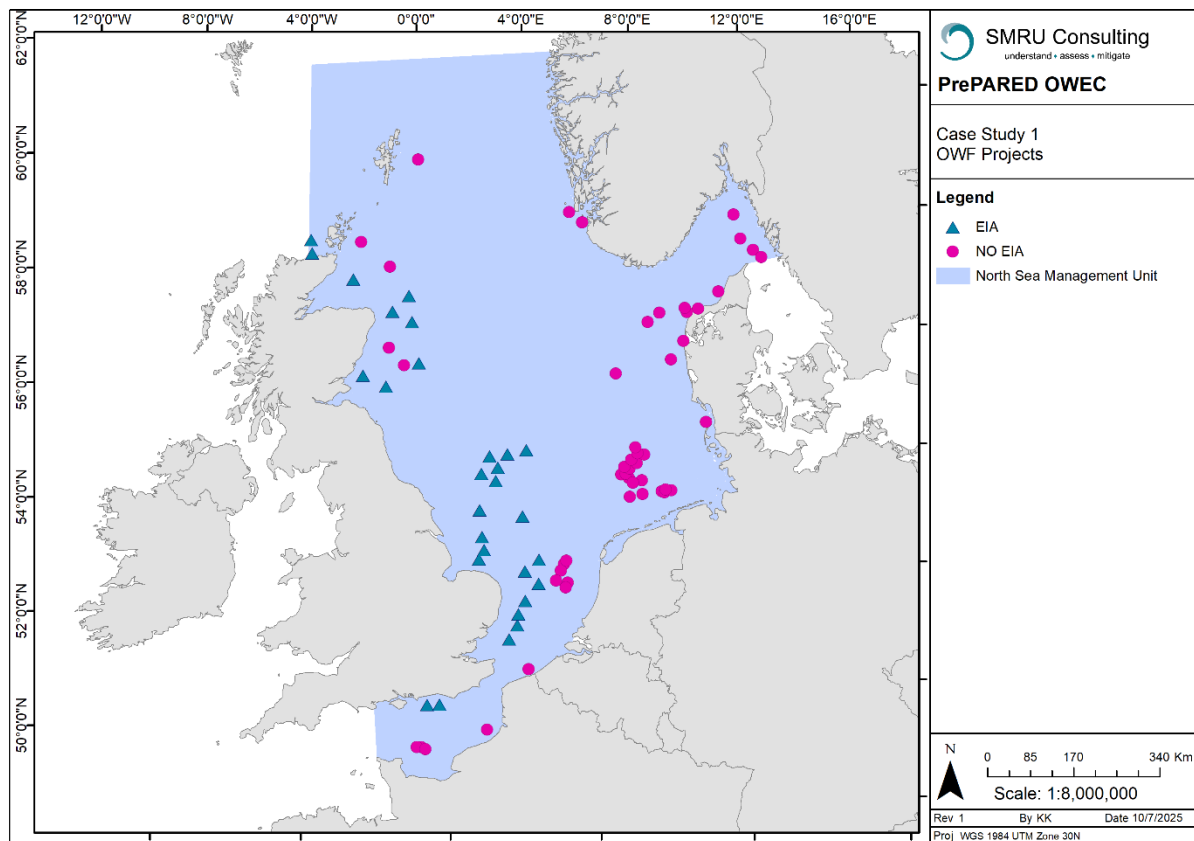
|                               |         |          |     |     |      |      |     |
|-------------------------------|---------|----------|-----|-----|------|------|-----|
| <b>Thybo II</b>               | Denmark | Fixed    | 88  | 176 | 2025 | 2029 | 334 |
| <b>Utsira Nord 1</b>          | Norway  | Floating | 100 | 400 | 2028 | 2030 | 87  |
| <b>Utsira Nord 2</b>          | Norway  | Floating | 33  | 133 | 2028 | 2030 | 87  |
| <b>Vest Nordsoen II + III</b> | Denmark | Fixed    | 67  | 133 | 2024 | 2027 | 435 |
| <b>Vidar</b>                  | Sweden  | Floating | 93  | 373 | 2027 | 2031 | 367 |
| <b>Vigso Bay</b>              | Denmark | Fixed    | 22  | 45  | 2026 | 2030 | 334 |

The screening and data collection resulted in **Scenario 1: EIA Projects Only** consisting of 31 OWF operations, piling between January 2025 and December 2038 inclusive, resulting in 5,439 piling days. **Scenario 2: All Projects** consisted of 80 OWF operations, piling between January 2025 and December 2038 inclusive, resulting in 13,704 piling days (Table 3 and Figure 1).

**Table 3 Summary of the OWF inputs to the iPCoD model under both scenarios.**

| Input                                 |      | Scenario 1: EIA Projects Only | Scenario 2: All Projects |
|---------------------------------------|------|-------------------------------|--------------------------|
| Number of OWF projects                |      | 28                            | 77                       |
| Number of OWF operations <sup>1</sup> |      | 31                            | 80                       |
| Start piling                          |      | Jan 2025                      | Jan 2025                 |
| End piling                            |      | Dec 2038                      | Dec 2038                 |
| Number of piling years                |      | 14                            | 14                       |
| Total number of piling days           |      | 5,439                         | 13,704                   |
| Total piling days per year            | 2025 | 391                           | 821                      |
|                                       | 2026 | 789                           | 1,639                    |
|                                       | 2027 | 1,272                         | 2,405                    |
|                                       | 2028 | 1,109                         | 2,766                    |
|                                       | 2029 | 517                           | 2,279                    |
|                                       | 2030 | 612                           | 2,207                    |
|                                       | 2031 | 232                           | 872                      |
|                                       | 2032 | 85                            | 283                      |
|                                       | 2033 | 85                            | 85                       |
|                                       | 2034 | 85                            | 85                       |
|                                       | 2035 | 85                            | 85                       |
|                                       | 2036 | 85                            | 85                       |
|                                       | 2037 | 83                            | 83                       |
|                                       | 2038 | 9                             | 9                        |

<sup>1</sup> In certain instances, an OWF project may have multiple “operations” within it. For example, if a different number of animals were predicted to be disturbed by different foundation types within an OWF project.



**Figure 1 OWF projects screened into Scenario 1 (EIA projects, blue triangles) and Scenario 2 (all projects, magenta circles).**

## **2.1 Population modelling**

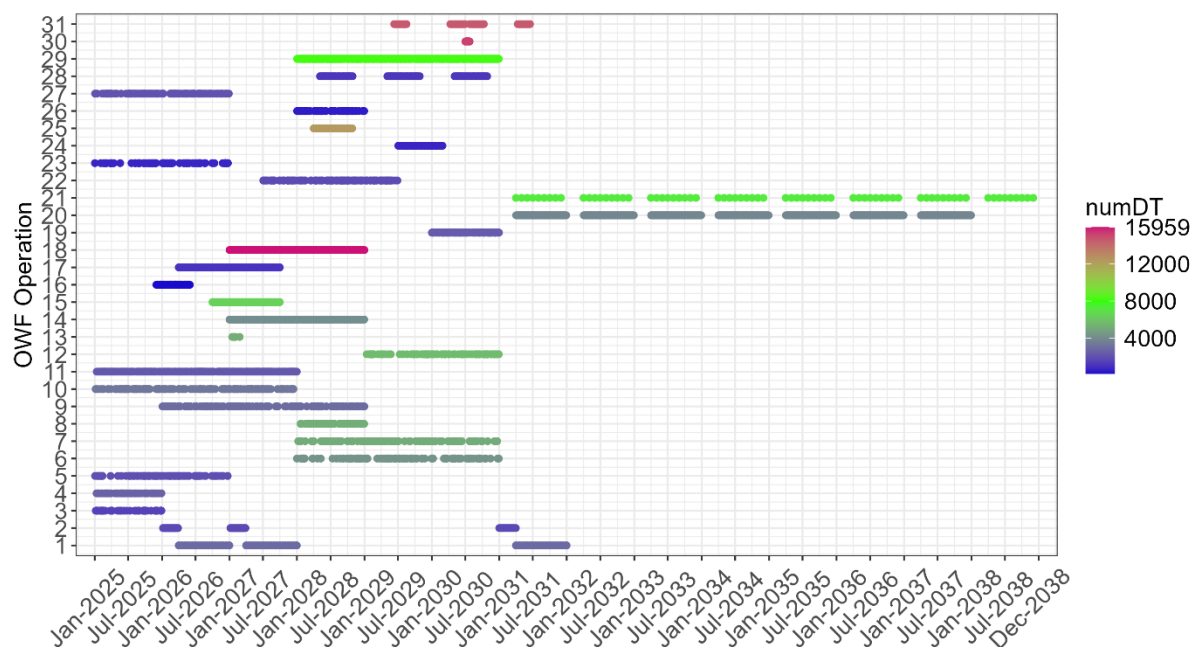
The interim Population Consequences of Disturbance (iPCoD) framework (Harwood et al. 2014, King et al. 2015) was used to predict the potential population consequences of disturbance resulting from the piling from OWFs in the North Sea MU for harbour porpoise under each scenario. The iPCoD model uses a stage structured model of population dynamics with nine age classes and one stage class (adults 10 years and older). The model is used to run a number of simulations of future population trajectory with and without the predicted level of impact, to allow an understanding of the potential future population level consequences of predicted behavioural responses.

Each iPCoD model simulation is run with matched pairs of populations: one un-impacted population and one impacted population (1,000 simulations are recommended for each scenario of interest). These matched-pairs experience exactly the same environmental and demographic stochasticity within one simulation of the model. The only variable element between the matched pair is that one population is subjected to a stressor (impulsive noise) and therefore demonstrates the potential effect of disturbance (this is the impacted population in the pair), the other population in the pair receives no exposure to a stressor and is the un-impacted population. Thus, any difference in the resulting modelled population size between the un-impacted and the impacted populations is entirely due to the effect of the disturbance modelled.

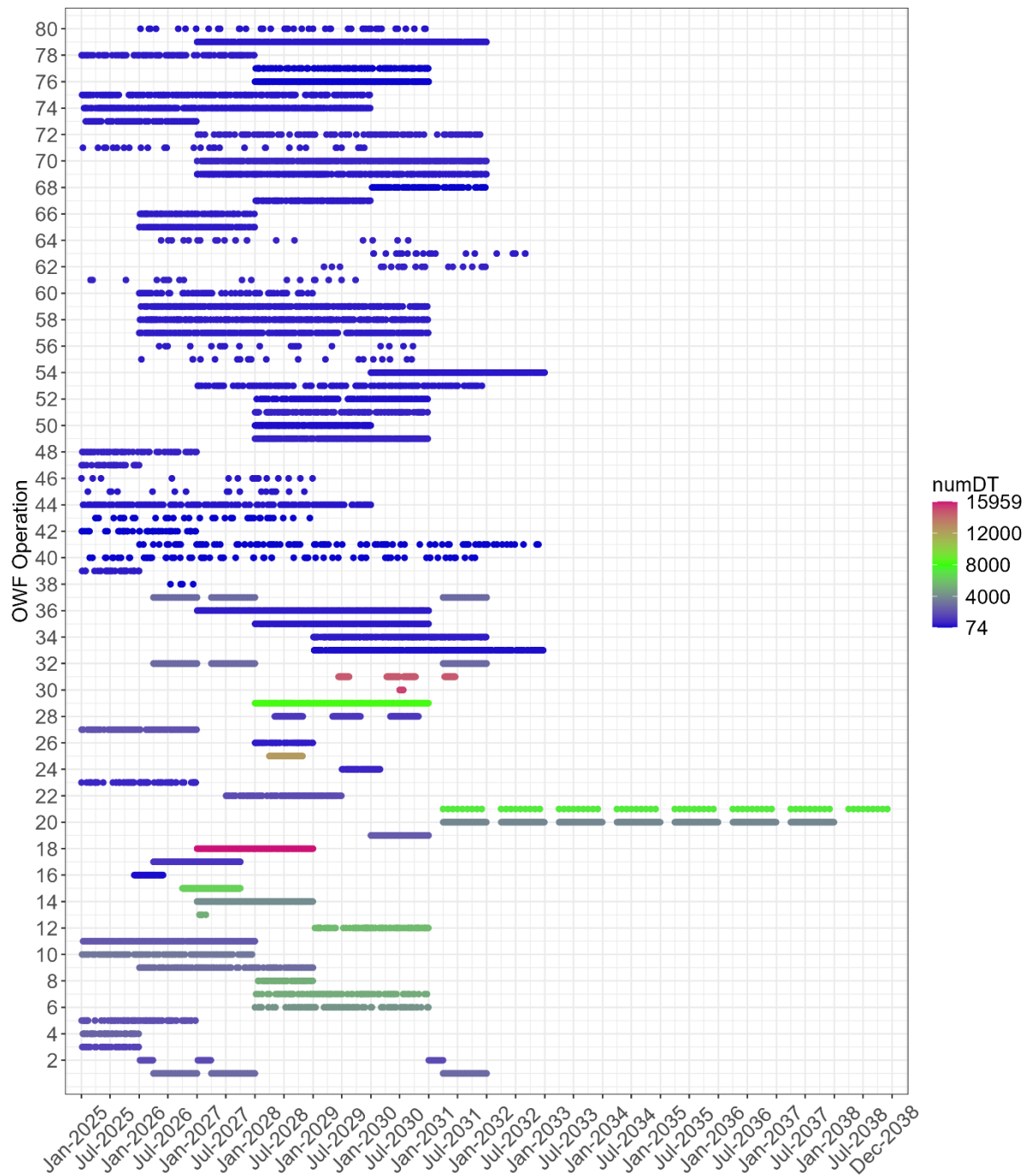
Table 4 provides a summary of the porpoise values input to the iPCoD model under both scenarios.

**Table 4 Summary of the porpoise inputs to the iPCoD model under both scenarios.**

| Input             |                                            | Scenario 1: EIA Projects Only          | Scenario 2: All Projects                           |
|-------------------|--------------------------------------------|----------------------------------------|----------------------------------------------------|
| <b>Spec</b>       | Species                                    | HP (harbour porpoise)                  |                                                    |
| <b>Pmean</b>      | Population size                            | 346,601 (IAMMWG 2023)                  |                                                    |
| <b>Surv[1]</b>    | Calf survival                              | 0.8455 (Sinclair et al. 2020)          |                                                    |
| <b>Surv[7]</b>    | Juvenile survival                          | 0.85 (Sinclair et al. 2020)            |                                                    |
| <b>Surv[13]</b>   | Adult survival                             | 0.925 (Sinclair et al. 2020)           |                                                    |
| <b>Fertility</b>  | Fertility                                  | 0.34 (Sinclair et al. 2020)            |                                                    |
| <b>Age 1</b>      | Age at independence                        | 1 (Sinclair et al. 2020)               |                                                    |
| <b>Age 2</b>      | Age of first birth                         | 5 (Sinclair et al. 2020)               |                                                    |
| <b>Pile years</b> | Number of years with piling                | 14                                     |                                                    |
| <b>Vulnmean</b>   | Vulnerable subpopulation                   | no                                     |                                                    |
| <b>days</b>       | Residual days of disturbance               | 0                                      |                                                    |
| <b>Pilesx1</b>    | Number of piling operations                | 31                                     | 80                                                 |
| <b>numDT</b>      | Number of animals disturbed per piling day | OWF specific: see Table 1 and Figure 2 | OWF specific: see Table 1 and Table 2 and Figure 3 |



**Figure 2 Piling schedules for all OWF operations included in Scenario 1: EIA Projects Only, showing their corresponding number of animals disturbed per piling day (numDT).**



**Figure 3 Piling schedules for all OWF operations included in Scenario 2: All Projects, showing their corresponding number of animals disturbed per piling day (numDT).**

### 3. Results

Figure 4 presents the predicted population size for the un-impacted and impacted North Sea MU population under **Scenario 1: EIA Projects Only**.

Figure 5 presents the predicted population size for the un-impacted and impacted North Sea MU population under **Scenario 2: All Projects**.

Table 5 provides the mean predicted population size for the un-impacted and impacted North Sea MU population under both scenarios in each of the 25 years modelled.

Intuitively, given that:

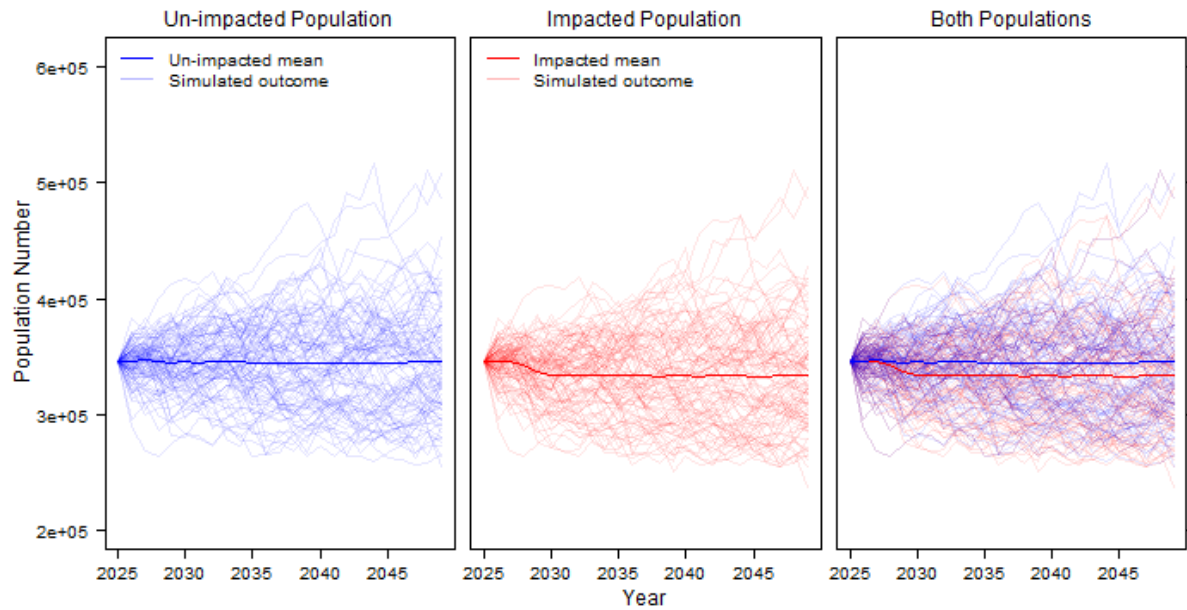
- the number of OWF projects considered in **Scenario 2: All Projects** was 2.8 x larger than the number considered in **Scenario 1: EIA Projects Only** (77 vs 28), and
- the total number of piling days considered in **Scenario 2: All Projects** was 2.5 x larger than considered in **Scenario 1: EIA Projects Only** (13,704 vs 5,439 days),

it was expected that **Scenario 2: All Projects** would result in a significantly larger impact to the North Sea MU population. However, this was not the case.

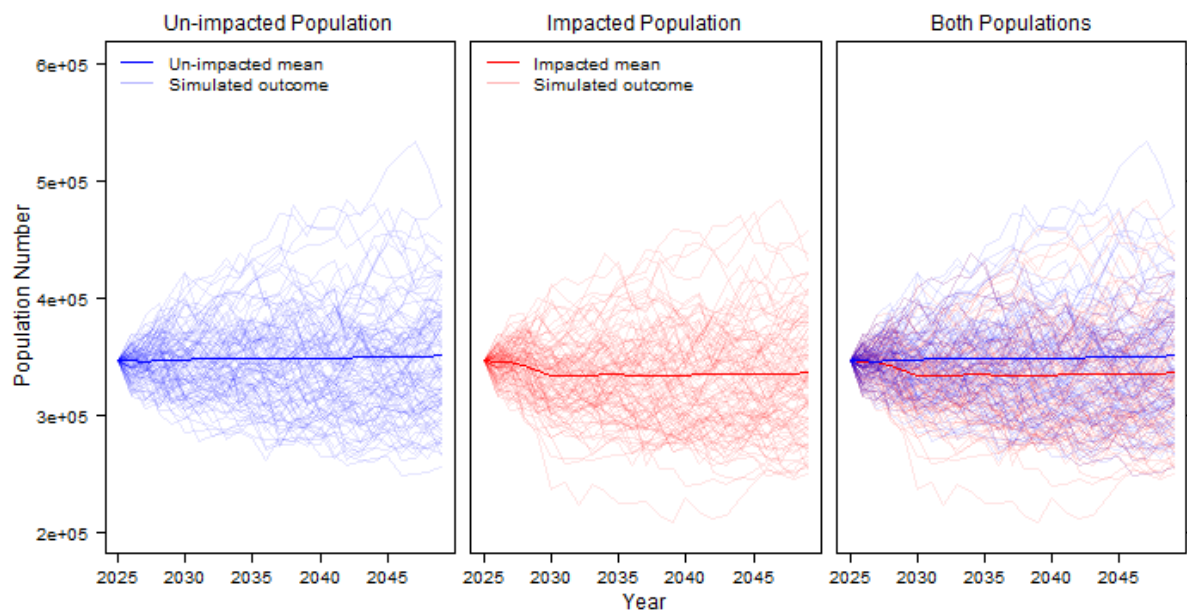
The mean impacted North Sea MU population under Scenario 1 dropped to 96.7% of the mean un-impacted population size, while for Scenario 2 it only dropped to 96.0% of the mean un-impacted population size (Table 5). Thus, there was almost no difference in the population level results between the two scenarios, despite substantially different inputs.

The reason for this is apparent when comparing the number of animals potentially disturbed between Scenario 1 and Scenario 2 (Table 6). The number of animals predicted to be impacted using an EDR approach combined with the SCANS IV density results is substantially lower than what is calculated in EIAs. This is because the EIAs use different disturbance thresholds (e.g. dose-response) and density surfaces (e.g. site-specific surveys). For example, the Five Estuaries EIA predicts disturbance to 5,677 porpoise per piling day for pin piles, using the site-specific digital aerial survey density (1.82 porpoise/km<sup>2</sup>) and the Graham et al. (2017) dose-response function. Using the 15 km EDR and SCANS IV density (0.3096 porpoise/km<sup>2</sup>) approach, only 219 porpoise are predicted to be disturbed. Thus, the number of animals predicted to be disturbed under the EDR and SCANS IV calculation is only 4% of the number of animals predicted to be disturbed in the EIA (Table 6). Therefore, the results from the two different methods are markedly different and incompatible, and caution used when comparing.

This means that the inclusion of non-EIA projects in Scenario 2, with such small numbers of animals disturbed per OWF, makes almost no difference compared to the result from Scenario 1 which included only EIA projects. If all non-EIA projects actually had an EIA available, it is expected that the number of animals disturbed per project would be substantially higher and thus far more likely to have a greater population level effect.



**Figure 4 Predicted population size for the un-impacted and impacted North Sea MU population under Scenario 1: EIA Projects Only.**



**Figure 5 Predicted population size for the un-impacted and impacted North Sea MU population under Scenario 2: All Projects (all OWF operations in the North Sea MU both with and without an EIA available).**

**Table 5 Mean predicted population size for the un-impacted and impacted North Sea MU population under each Scenario (piling occurs between 2025 and 2038 inclusive)**

| Year       | Scenario 1: EIA Projects Only    |                               |                                                   | Scenario 2: All Projects         |                               |                                                   |
|------------|----------------------------------|-------------------------------|---------------------------------------------------|----------------------------------|-------------------------------|---------------------------------------------------|
|            | Mean un-impacted population size | Mean impacted population size | Mean impacted population size as % of un-impacted | Mean un-impacted population size | Mean impacted population size | Mean impacted population size as % of un-impacted |
| Start 2025 | 346,602                          | 346,602                       | 100.0%                                            | 346,602                          | 346,602                       | 100.0%                                            |
| End 2025   | 346,683                          | 346,578                       | 100.0%                                            | 345,986                          | 345,830                       | 100.0%                                            |
| End 2026   | 347,251                          | 346,727                       | 99.9%                                             | 345,724                          | 344,987                       | 99.8%                                             |
| End 2027   | 346,483                          | 343,154                       | 99.0%                                             | 346,561                          | 342,527                       | 98.8%                                             |
| End 2028   | 345,223                          | 337,100                       | 97.7%                                             | 347,210                          | 337,430                       | 97.2%                                             |
| End 2029   | 345,393                          | 334,444                       | 96.8%                                             | 346,661                          | 333,519                       | 96.2%                                             |
| End 2030   | 345,232                          | 333,893                       | 96.7%                                             | 347,405                          | 333,556                       | 96.0%                                             |
| End 2031   | 345,518                          | 333,591                       | 96.6%                                             | 347,418                          | 332,792                       | 95.8%                                             |
| End 2032   | 345,896                          | 334,656                       | 96.8%                                             | 348,036                          | 334,120                       | 96.0%                                             |
| End 2033   | 345,751                          | 334,740                       | 96.8%                                             | 347,802                          | 334,172                       | 96.1%                                             |
| End 2034   | 345,002                          | 333,961                       | 96.8%                                             | 348,078                          | 334,400                       | 96.1%                                             |
| End 2035   | 344,911                          | 333,687                       | 96.8%                                             | 347,900                          | 334,019                       | 96.0%                                             |
| End 2036   | 344,947                          | 333,566                       | 96.7%                                             | 347,775                          | 333,700                       | 96.0%                                             |
| End 2037   | 344,895                          | 333,403                       | 96.7%                                             | 348,130                          | 333,935                       | 95.9%                                             |
| End 2038   | 344,945                          | 333,423                       | 96.7%                                             | 347,501                          | 333,306                       | 95.9%                                             |
| End 2039   | 344,895                          | 333,421                       | 96.7%                                             | 348,101                          | 333,953                       | 95.9%                                             |
| End 2040   | 344,820                          | 333,393                       | 96.7%                                             | 348,446                          | 334,328                       | 96.0%                                             |
| End 2041   | 345,013                          | 333,540                       | 96.7%                                             | 348,655                          | 334,513                       | 95.9%                                             |
| End 2042   | 345,296                          | 333,813                       | 96.7%                                             | 349,638                          | 335,478                       | 96.0%                                             |
| End 2043   | 345,165                          | 333,652                       | 96.7%                                             | 349,755                          | 335,573                       | 96.0%                                             |
| End 2044   | 344,489                          | 333,019                       | 96.7%                                             | 349,423                          | 335,292                       | 96.0%                                             |
| End 2045   | 344,615                          | 333,143                       | 96.7%                                             | 349,550                          | 335,405                       | 96.0%                                             |
| End 2046   | 345,976                          | 334,486                       | 96.7%                                             | 349,217                          | 335,085                       | 96.0%                                             |
| End 2047   | 345,665                          | 334,159                       | 96.7%                                             | 349,534                          | 335,388                       | 96.0%                                             |
| End 2048   | 345,524                          | 334,015                       | 96.7%                                             | 350,715                          | 336,512                       | 96.0%                                             |
| End 2049   | 345,428                          | 333,923                       | 96.7%                                             | 350,887                          | 336,692                       | 96.0%                                             |

**Table 6 Difference in the number of porpoise disturbed (# HP) between EIA values and what would have been estimated if no EIA was available (based on an EDR and the SCANS IV block density (# porpoise/km<sup>2</sup>, from Gilles et al. (2023))).**

| OWF                  | Pile         | EIA # HP | SCANS IV Density | EDR (km) | Assumed # HP | Assumed as % EIA |
|----------------------|--------------|----------|------------------|----------|--------------|------------------|
| Berwick Bank         | Pin          | 2,822    | 0.5985           | 15       | 423          | 15%              |
| Dogger Bank A        | Mono         | 1,470    | 0.6027           | 26       | 1,280        | 87%              |
| Dogger Bank B        | Mono         | 2,599    | 0.6027           | 26       | 1,280        | 49%              |
| Dogger Bank C        | Mono         | 1,920    | 0.8034           | 26       | 1,706        | 89%              |
| Dogger Bank SE       | Mono         | 4,296    | 0.6027           | 26       | 1,280        | 30%              |
| Dogger Bank SW       | Mono         | 5,098    | 0.6027           | 26       | 1,280        | 25%              |
| Dudgeon Ext          | Mono         | 5,161    | 0.6027           | 26       | 1,280        | 25%              |
| East Anglia 1 N      | Pin          | 2,914    | 0.3096           | 15       | 219          | 8%               |
| East Anglia 2        | Pin          | 3,285    | 0.3096           | 15       | 219          | 7%               |
| East Anglia 3        | Pin          | 2,211    | 0.3096           | 15       | 219          | 10%              |
| Five Estuaries       | Pin          | 5,677    | 0.3096           | 15       | 219          | 4%               |
| Green Volt OSP       | Pin          | 5,208    | 0.5985           | 15       | 423          | 8%               |
| Hornsea 3            | Pin          | 4,046    | 0.6027           | 15       | 426          | 11%              |
| Hornsea 4            | Pin          | 6,417    | 0.6027           | 15       | 426          | 7%               |
| Morecambe            | Mono         | 3,443    | 0.5153           | 26       | 1,094        | 32%              |
| Norfolk Boreas       | Pin          | 1,016    | 0.3096           | 15       | 219          | 22%              |
| Norfolk Vanguard     | Pin          | 15,959   | 0.3096           | 15       | 219          | 1%               |
| North Falls          | Pin          | 2,274    | 0.3096           | 15       | 219          | 10%              |
| Ossian (WTG)         | Anchor       | 3,857    | 0.5985           | 15       | 423          | 11%              |
| Ossian (OSP)         | Pin          | 7,309    | 0.5985           | 15       | 423          | 6%               |
| Outer Dowsing        | Pin          | 1,799    | 0.6027           | 15       | 426          | 24%              |
| Pentland             | Anchor       | 641      | 0.2813           | 15       | 199          | 31%              |
| Rampion 2            | Pin          | 652      | 0.1045           | 15       | 74           | 11%              |
| Salamander           | Anchor       | 12,366   | 0.5985           | 15       | 423          | 3%               |
| Sheringham Shoal Ext | Pin          | 445      | 0.6027           | 15       | 426          | 96%              |
| Sofia                | Mono         | 2,035    | 0.6027           | 26       | 1,280        | 63%              |
| West of Orkney       | Pin          | 1,149    | 0.0994           | 15       | 70           | 6%               |
| Caledonia            | Pin & anchor | 8,201    | 0.2813           | 15       | 199          | 2%               |
| Muir Mhòr (OSP)      | Pin          | 15,245   | 0.5985           | 15       | 423          | 3%               |
| Muir Mhòr (WTG)      | Anchor       | 14,630   | 0.5985           | 15       | 423          | 3%               |

## 4. Recommendations

Despite **Scenario 1: EIA Projects Only** having fewer OWF operations (n=31) and fewer piling days (n=5,439), the results at the population level were almost identical to those from **Scenario 2: All Projects** which had more OWF operations (n=80) and more piling days (n=13,704). The reason the population level result was almost identical between the two scenarios is due to the difference in how the number of animals disturbed per piling day is calculated in EIAs compared to using the EDR and SCANS IV calculation for projects without an EIA.

By using the EDR and SCANS IV calculation, in most cases, the predicted number of animals disturbed is substantially less than is predicted in EIAs which use different disturbance thresholds and density surfaces. Therefore, the results from the two different methods are markedly different and incompatible, and caution used when comparing.

One way to address this incomparability would be to standardise the inputs to the CEA. For example, use the EDR and SCANS IV calculation for all OWF projects scoped into the assessment, whether or not they have an EIA available. However, this risks significantly underestimating the potential disturbance levels compared to an assessment that uses OWF specific density surfaces and a dose-response approach. Alternatively, the CEA could scope out projects without an EIA to avoid this incompatibility, but this risks significantly underestimating the potential disturbance levels as it doesn't consider all potential projects within an MU.

Given this issue, **it is recommended** that Regulators and Statutory Advisors provide clear guidance as to what methods should be used in a CEA, how best to account for projects without an EIA, and how to interpret the results if both methods are used in a single assessment.

## 5. References

- Gilles, A., M. Authier, N. Ramirez-Martinez, H. Araújo, A. Blanchard, J. Carlström, C. Eira, G. Dorémus, C. Fernández-Maldonado, S. Geelhoed, L. Kyhn, S. Laran, D. Nachtsheim, S. Panigada, R. Pigeault, M. Sequeira, S. Sveegaard, N. Taylor, K. Owen, C. Saavedra, J. Vázquez-Bonales, B. Unger, and P. Hammond. 2023. Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023.
- Graham, I. M., A. Farcas, N. D. Merchant, and P. Thompson. 2017. Beatrice Offshore Wind Farm: An interim estimate of the probability of porpoise displacement at different unweighted single-pulse sound exposure levels. Prepared by the University of Aberdeen for Beatrice Offshore Windfarm Ltd.
- Harwood, J., S. King, R. Schick, C. Donovan, and C. Booth. 2014. A protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) approach: Quantifying and assessing the effects of UK offshore renewable energy developments on marine mammal populations. Report Number SMRUL-TCE-2013-014. Scottish Marine And Freshwater Science, 5(2).
- IAMMWG. 2023. Review of Management Unit boundaries for cetaceans in UK waters (2023). JNCC Report 734, JNCC, Peterborough, ISSN 0963-8091.

- JNCC. 2020. Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland). Report No. 654, JNCC, Peterborough.
- King, S. L., R. S. Schick, C. Donovan, C. G. Booth, M. Burgman, L. Thomas, and J. Harwood. 2015. An interim framework for assessing the population consequences of disturbance. *Methods in Ecology and Evolution* **6**:1150-1158.
- Sinclair, R., J. Harwood, and C. Sparling. 2020. Review of demographic parameters and sensitivity analysis to inform inputs and outputs of population consequences of disturbance assessments for marine mammals. *Scottish Marine and Freshwater Science* **11**:74.
- Sinclair, R. R. 2025. PrePARED Report: Challenges and Solutions for Offshore Wind Farm Cumulative Effects Assessments for Marine Mammals.

## 6. EIAs reviewed

| OWF                                    | EIA Report Reference                                                                                                                                                                                                                                                                 |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Berwick Bank                           | Berwick Bank Wind Farm. Environmental Impact Assessment Report. Volume 2, Chapter 10: Marine Mammals. Document EOR0766. Version: Final. October 2022.                                                                                                                                |
| Dogger Bank A (Creyke Beck A)          | Dogger Bank Creyke Beck Environmental Statement. Chapter 14 Marine Mammals. Application Reference 6.14. Document Number: F-OFC-CH-014. August 2013.                                                                                                                                  |
| Dogger Bank B (Creyke Beck B)          |                                                                                                                                                                                                                                                                                      |
| Dogger Bank C (Dogger Bank Teesside A) | Dogger Bank Teesside A & B Environmental Statement. Chapter 14 Marine Mammals. Application Reference 6.14. Document Number: F-OFC-CH-014. March 2014.                                                                                                                                |
| Dogger Bank SE                         | RWE Renewables UK Dogger Bank South (West) Limited RWE Renewables UK Dogger Bank South (East) Limited Dogger Bank South Offshore Wind Farms Environmental Statement, Volume 7 Chapter 11 – Marine Mammals. Application ref: 7.11. APFP Regulation: 5(2)(a). Revision: 01. June 2024. |
| Dogger Bank SW                         |                                                                                                                                                                                                                                                                                      |
| Dudgeon Extension                      | Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects. Environmental Statement. Volume 1. Chapter 10 - Marine Mammal Ecology. Document Reference: 6.1.10. APFP Regulation: 5(2)(a). August 2022.                                                                        |
| East Anglia 1 N                        | East Anglia ONE North Offshore Windfarm. Chapter 11 Marine Mammals. Environmental Statement Volume 1. Document Reference: 6.1.11. APFP Regulation: 5(2)(a). October 2019.                                                                                                            |
| East Anglia 2                          | East Anglia TWO Offshore Windfarm. Chapter 11 Marine Mammals. Environmental Statement Volume 1. Document Reference: 6.1.11. APFP Regulation: 5(2)(a). October 2019.                                                                                                                  |
| East Anglia 3                          | East Anglia THREE. Chapter 12 Marine Mammal Ecology. Environmental Statement Volume 1. Document reference – 6.1.12. November 2015.                                                                                                                                                   |
| Five Estuaries                         | Five Estuaries Offshore Wind Farm Environmental Statement. Volume 6, Part 2, Chapter 7: Marine Mammal Ecology. Application Reference EN010115. Application Document Number 6.2.7. Revision A. APFP Regulation 5(2)(a). March 2024.                                                   |
| Green Volt                             | Green Volt Offshore EIA Report: Volume 1. Chapter 11 Marine Mammal Ecology. January 2023.                                                                                                                                                                                            |

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|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hornsea 3                      | Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 2, Chapter 4 – Marine Mammals. PINS Document Reference: A6.2.4. APFP Regulation 5(2)(a). May 2018.                                   |
| Hornsea 4                      | Hornsea Project Four: Environmental Statement (ES). PINS Document Reference: A2.4. APFP Regulation: 5(2)(a). Volume A2, Chapter 4: Marine Mammals. Doc. No. A2.4 Version B. September 2021.                   |
| Morecambe                      | Morecambe Offshore Windfarm: Generation Assets. Environmental Statement. Volume 5. Chapter 11 Marine Mammals. PINS Document Reference: 5.1.11. APFP Regulation: 5(2)(a). Rev 01. May 2024.                    |
| Norfolk Boreas                 | Norfolk Boreas Offshore Wind Farm. Chapter 12 Marine Mammal Ecology. Environmental Statement Volume 1. Document Reference: 6.1.12. APFP Regulation: 5(2)(a). Revision: Version 1. June 2019.                  |
| Norfolk Vanguard               | Norfolk Vanguard Offshore Wind Farm. Chapter 12 Marine Mammals. Environmental Statement Volume 1. Document Reference: 6.1.12. APFP Regulation 5(2)(a). Revision: Version 1. June 2018.                        |
| North Falls                    | North Falls Offshore Wind Farm. Environmental Statement. Chapter 12 Marine Mammals. Document Reference 3.1.14. Volume 3.1. APFP Regulation: 5(2)(a). July 2024.                                               |
| Ossian                         | Ossian. Chapter 10: Marine Mammals. Array EIA Report. June 2024                                                                                                                                               |
| Outer Dowsing                  | Outer Dowsing Offshore Wind. Environmental Statement. Chapter 11 Marine Mammals. Volume 1. Document Reference: 6.1.11. Pursuant to APFP Regulation: 5(2)(a). Rev: 1. March 2024.                              |
| Pentland                       | Pentland floating offshore wind farm. Volume 2: Offshore EIAR. Chapter 11: Marine Mammals and Other Megafauna. Document no. GBPNTD-ENV-XOD-RP-00006. Revision 01. July 2022.                                  |
| Rampion 2                      | Rampion 2 Wind Farm Category 6: Environmental Statement Volume 2, Chapter 11: Marine mammals Date: Revision E. August 2024                                                                                    |
| Salamander                     | Salamander Offshore Wind Farm. Offshore EIA Report. Volume ER.A.3, Chapter 11: Marine Mammals. Document no: 08435483. Revision 00. April 2024.                                                                |
| Sheringham Shoal Extension     | Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects. Environmental Statement. Volume 1. Chapter 10 - Marine Mammal Ecology. Document Reference: 6.1.10. APFP Regulation: 5(2)(a). August 2022. |
| Sofia (Dogger Bank Teesside B) | Dogger Bank Teesside A & B Environmental Statement. Chapter 14 Marine Mammals. Application Reference 6.14. Document Number: F-OFC-CH-014. March 2014.                                                         |
| West of Orkney                 | West of Orkney Windfarm. Offshore EIA Report. Volume 1, Chapter 12 - Marine Mammals and Megafauna. DOCUMENT L-100632-S05-A -ESIA-012. September 2023.                                                         |
| Caledonia                      | Caledonia Offshore Wind Farm. Volume 2 Proposed Development (Offshore) Chapter 7 Marine Mammals. Code UKCAL-CWF-CON-EIA-RPT-00002-2007. Revision: Issued. October 2024.                                       |
| Muir Mhòr                      | Muir Mhòr Offshore Wind Farm. Environmental Impact Assessment Report Volume 2, Chapter 12: Marine Mammals. Document ID MMH-GBE-A004-ENV-0006-205. Revision 01. November 2024.                                 |